National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
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Houston, Texas 77058-3696

May 13, 2005

EA-05-036

TO: Award Committee, NASA Software of the Year Award

FROM: EA/AMS Deputy Project Manager

SUBJECT: Letter of Endorsement for BUMPER Micrometeoroid Orbital Debris
             (MMOD) Risk Assessment Code

I am very pleased to endorse the BUMPER code for the 2005 NASA Software of the
Year Award. The BUMPER code has been used to develop the micrometeoroid and
orbital debris (MMOD) shielding used on the Alpha Magnetic Spectrometer (AMS)
experiment that is being prepared for launch to the International Space Station in 2008.
As the first magnetic spectrometer in space, the purpose of the AMS is to detect
antimatter and dark matter data from cosmic sources emanating from stars and galaxies
millions of light years beyond the Milky Way. The 14,809 pound AMS payload is
designed and constructed by an international team of over 450 physicists and engineers
from over 50 institutions and companies in 16 countries.

The AMS contains several pressurized vessels that require adequate MMOD protection to
ensure safe and successful operation of the experiment. MMOD punctures to any of the
pressure vessels contained on AMS could end or shorten the experiment, or in worst case
could cause a rupture of the pressure vessels threatening other equipment or modules on
ISS. We, therefore, have used BUMPER to perform MMOD risk assessments, and to
determine the parameter of the MMOD protection for the AMS hardware to meet safety
and mission success requirements. We have sponsored hypervelocity impact tests on
relevant AMS hardware, the results of which are used to develop ballistic penetration
equations for use in BUMPER code analyses. We are currently involved in a number of
BUMPER code assessments of AMS hardware to support final design reviews.

From the results to-date, we believe the BUMPER code is an excellent tool for MMOD
risk assessments and protection design. We anticipate continued use of BUMPER code
to support final MMOD shielding design and certification of AMS hardware to support
the 2008 launch.

Trent Martin